

Asbestos Facts Sheet

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What is asbestos?

Asbestos is not a single substance, but is rather the generic name for a group of six fibrous silicate minerals of which one, chrysotile, belongs to the serpentine family and five: actinolite, amosite, anthophyllite, crocidolite, and tremolite, belong to the amphibole family.

Asbestiform refers to a subset of fibrous minerals that exhibit the additional qualities of flexibility and separability of individual fibers. Typically, asbestiform minerals also have relatively small fiber diameters (usually under 1 micron) and long fiber lengths (>5-10 microns). [1 micron = 1/1000 of a millimeter]

The asbestos minerals differ from each other in their physical and chemical properties, and each mineral can exist in a wide range of fiber sizes. These differences between fiber type and, more importantly, fiber size (length and diameter) are believed to be important determinants of the health risks posed by asbestos.

Chrysotile possesses relatively long, flexible, and wavy fibers. Amphibole asbestos has fibers that are substantially more brittle than chrysotile.

An important chemical distinction is that all of the amphibole minerals contain significant iron whereas chrysotile does not contain appreciable iron. Iron can react with oxygen in the lungs to produce iron oxide precipitates that form a solid coating around the amphibole fiber, which is an important distinction between the toxicity of the two minerals.

Chrysotile currently accounts for 99% of world's commercial, purposeful use of asbestos [NIOSH 2011].

99.7% of the asbestos fibers in McGill Hall were identified as chrysotile in the airborne and surface load testing. (http://www.umt.edu/facilities/asbestos/McGill_Hall_testing.pdf)

Sources:

ATSDR (Agency for Toxic Substances and Disease Registry). Toxicological Profile for Asbestos. Atlanta, GA: US Department of Health and Human Services; 2001.

Institute of Medicine (US) Committee on Asbestos: Selected Health Effects. Asbestos: Selected Cancers. Washington (DC): National Academies Press (US); 2006. 3, Background Information on Asbestos. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK20335/>

NIOSH Current Intelligence Bulletin 62: Asbestos Fibers and Other Elongate Mineral Particles: State of the Science and Roadmap for Research [Revised April 2011] (<https://www.cdc.gov/niosh/docs/2011-159/pdfs/2011-159.pdf>)

What is considered a fiber and what are typical fiber concentrations in the air we breathe every day?

Occupational Safety and Health Administration (OSHA) defines an asbestos fiber for counting purposes as a particle with a length $>5\text{ }\mu\text{m}$ and a length-to-width ratio (aspect ratio) $>3:1$. It should be noted that other government agencies use different definitions of asbestos fibers for counting purposes. For example, the EPA defines a fiber as any particle with an aspect ratio $>5:1$ when analyzing bulk samples for fiber content.

In general, levels of asbestos in air inside and outside buildings with undisturbed asbestos-containing materials are low, but indoor levels may be somewhat higher than outside levels. Currently, U.S. OSHA regulations require that workplace air concentrations of asbestos not to exceed 0.1 f/cc (fibers/cubic centimeter).

As a result of human use, asbestos fibers are now widely dispersed in the environment. Background levels in the air are extremely low, about 0.0001 f/cc (Holland and Smith, 2003).

For comparison, average airborne fiber levels in McGill Hall measured in January 2019 were mostly below the measurable detection limit of 0.0009 f/cc. One measurement from McGill Hall room 004/001A measured 0.0025 f/cc, which was the only measurement above the detection limit, containing 1 fiber of chrysotile.

Sources:

ATSDR (Agency for Toxic Substances and Disease Registry). *Toxicological Profile for Asbestos*. Atlanta, GA: US Department of Health and Human Services; 2001.

Holland, J. and Smith, D., 2003, *Asbestos. Occupational, industrial, and environmental toxicology*. In: Greenberg, M.I., Hamilton, R.J., Phillips, S.D., McClusky, G.J., eds. Philadelphia: Mosby, p. 650-669.

What is the difference between air sampling and surface dust sampling and can you extrapolate airborne concentrations from surface load numbers?

Two types of samples were taken in McGill Hall – accumulated dust wipe samples to determine surface loading and airborne measurements to determine airborne fiber concentrations. As stated above, the air samples indicate no measurable concentration of asbestos fibers. However, surface wipe samples contained relatively higher concentrations. **It is important to note that surface sampling represents accumulated dust and is not equivalent to airborne concentrations.**

In general surface sampling data may be useful in tracing the source of asbestos-containing dust, but it is not a good marker of risk since it does not represent airborne particulates. You can extrapolate surface concentration to airborne concentrations, but there are somewhat large uncertainties with this calculation. The relationship is:

$$\text{Airborne Concentration} = K \times \text{Surface Concentration}$$

K is a value called the “resuspension factor”. It is influenced by the surface area of the particle. Values have been estimated at 10^{-9} - 10^{-11} cm^{-1} by Fowler and Chatfield (1997) but these authors noted a large uncertainty in this estimation because of the variability in particle size and dimensions. **Nevertheless, these values can give a ballpark estimate of how to extrapolate surface sampling to airborne concentrations and when applied to the maximum values from McGill Hall this translates to 0.0004 to 0.004 f/cc, which is consistent with the majority of the air samples showing no detectable fibers.**

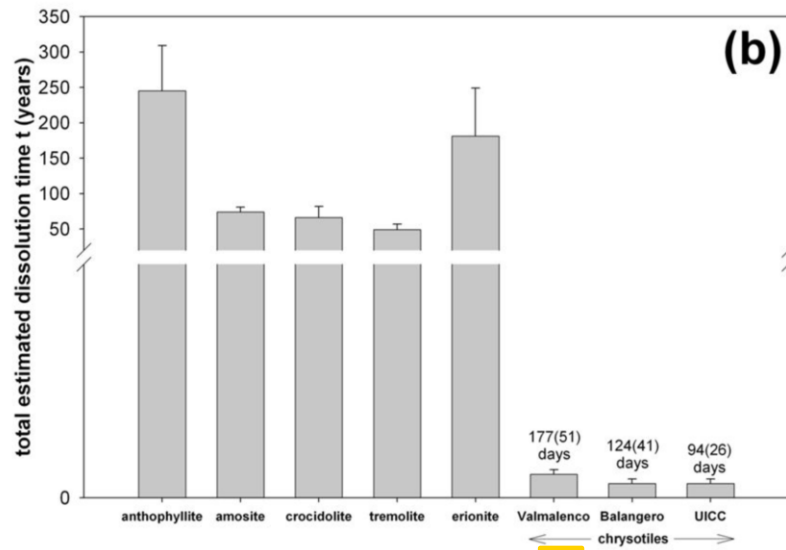
Source:

D. P. Fowler, E. J. Chatfield, 1997, Surface Sampling for Asbestos Risk Assessment, The Annals of Occupational Hygiene, Volume 41, Issue inhaled particles VIII, p. 279–286.

What do we know about how long asbestos fibers stay in our bodies?

A characteristic that contributes to the relative respiratory hazard of different fiber types is biopersistence. Biopersistence is defined as the ability of a fiber to be biodurable (to persist in the human body) and to survive physiological clearance. The available data suggest that chrysotile is deposited in the lung tissue but is cleared extremely rapidly, with the vast bulk of fibers removed from human lungs within weeks to months after inhalation. In comparison, amphibole clearance half-lives are of the order of years to decades (Churg, 1994). The potential for chrysotile fibers to dissolve while amphibole fibers are far more persistent may be relevant to the relative carcinogenicity of the two main fiber types.

Biodurability studies of chrysotile estimated lifetimes of about 9 months for a 1-micron-diameter fiber, and a model prediction that fibers with diameters of 0.1 micron would require only weeks to dissolve completely (Hume and Rimstidt, 1992). In another study, researchers found that the calculated dissolution time of a 0.25 micron thick fiber of chrysotile using a simulated lung fluid is in the range 94–177 days, very short if compared to that of amphibole fibers (49–245 years) (Gualtieri et al., 2018).



(from Gualtieri et al., 2018)

Thus there is general scientific consensus that chrysotile is more readily cleared from the body than amphibole forms.

Sources:

ACSH (American Council on Science and Health), <https://www.acsh.org/news/2018/07/18/acsh-explains-whats-story-asbestos-13206>

Churg A. 1994. Deposition and clearance of chrysotile asbestos. *Ann Occup Hyg* 38:625-633.

Gualtieri, A.F., Pollastri, Gandolfi, N.B., and Gualtieri, M.L., 2018, *In vitro* acellular dissolution of mineral fibres: A comparative study, *Scientific Reports*, v. 8, Article number: 7071.

Hume L.A., Rimstidt, J.D. The biodurability of chrysotile asbestos. *American Mineralogist*. 1992; 77: 1125–1128.

Institute of Medicine (US) Committee on Asbestos: Selected Health Effects. *Asbestos: Selected Cancers*. Washington (DC): National Academies Press (US); 2006. 3, Background Information on Asbestos. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK20335/>

Will a single asbestos fiber hurt me?

No one can say because it is impossible to conduct such a study. It is important to note that the general population is exposed to low levels of asbestos primarily by inhalation. Small quantities of asbestos fibers are ubiquitous in air. Here is a thought experiment to give you an idea of how many asbestos fibers humans are exposed to in an average lifetime.

1. Every 60 seconds, the lungs of a normal person handle some 5-8 liters of air.
2. In the general environmental air of cities and rural areas, concentrations of approximately 0.1 fiber per liter (possibly a little more or a little less, depending on circumstances of location) are found around the world.
3. Each day a “normal” non-occupationally exposed person breathes on average around 11,000 liters of air, each one containing an average of 0.1 fiber (assuming a value of 0.0001 fibers/cc).

4. This means in an average lifetime (~27,375 days) a person is likely exposed to over 30 million asbestos fibers.

Source:

(modified for published average air quality and lung volume values from the Mesothelioma Research Foundation of America - <http://www.mesorfa.org>)

Have Minimal Risk Levels been established for short duration, non-occupational exposure to asbestos?

Data regarding the adverse health effects associated with acute- or intermediate-duration exposure to asbestos are lacking or are too limited to support the derivation of a Minimal Risk Level. Only a few inhalation or oral studies have sought to determine the effects of short-term exposures to asbestos. There are no human data on noncancer effects after acute exposures, and no acute-duration Minimal Risk Levels have been derived.

Sources:

ATSDR (Agency for Toxic Substances and Disease Registry). Toxicological Profile for Asbestos. Atlanta, GA: US Department of Health and Human Services; 2001.

How can asbestos affect children?



In the small number of studies that have looked at asbestos exposure in children, there is no indication that younger people might develop asbestos-related diseases more quickly than older people.

Studies that have been conducted on asbestos levels in schools have stressed the low fiber counts in the air even when the buildings contained asbestos-containing material (Mossman et al. 1990).

Sources:

ATSDR (Agency for Toxic Substances and Disease Registry). Toxicological Profile for Asbestos. Atlanta, GA: US Department of Health and Human Services; 2001.

Mossman B.T., Bignon J., and Corn, M., 1990, Asbestos: Scientific developments and implications for public policy. Science 247:294-301.

Where can I get more information?

A good place to start is ATSDR (Agency for Toxic Substances and Disease Registry). Much of the information presented here is from their Toxicological Profile for Asbestos. A summary version of this report is here: <https://www.atsdr.cdc.gov/toxfaqs/tfacts61.pdf>

The full technical report may be found here: <https://www.atsdr.cdc.gov/toxprofiles/tp61.pdf>

ATSDR also has a public-facing website, Asbestos and Your Health, here: <https://www.atsdr.cdc.gov/asbestos/>